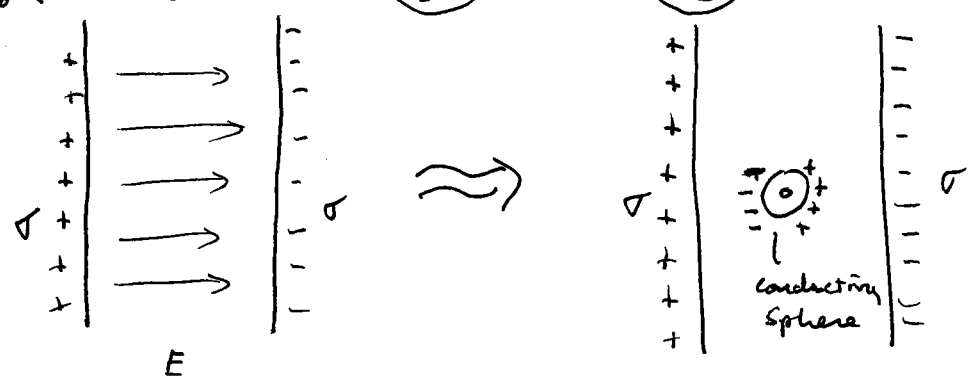


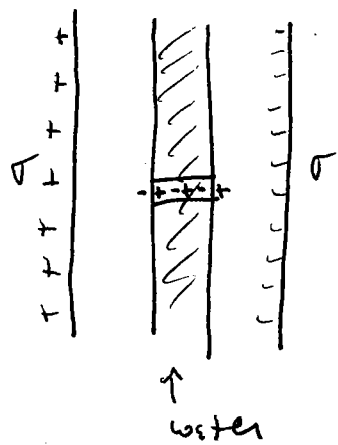
500 SHEETS FILLER 5 SQUARE
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 42-387 200 RECYCLED WHITE 5 SQUARE
 42-388 200 RECYCLED WHITE 5 SQUARE
 42-389 200 RECYCLED WHITE 5 SQUARE
 Made in U.S.A.

Dielectrics - insulator - charges do not flow freely
 can become polarized

Polar vs. nonpolar

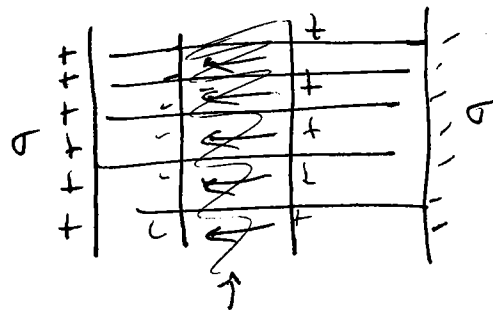


Force between plates (E field)
 increased due to induced charges



dipoles line up ... get induced surface charge
 Again E at plates increased slightly
 (less than if had placed conductor)

But inside dielectric



E is reduced

So, can reduce E between plates by filling w/ dielectric

So $|E| = \frac{V}{K \epsilon_0}$

reduced by $K \equiv$ dielectric constant $\epsilon > 1$

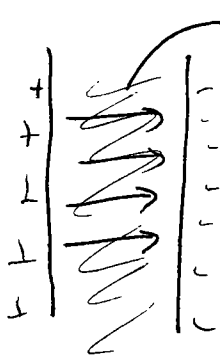
water $K = 80.4$

Air $K = 1.00054$

Vacuum $K \approx 1$

Oil $K = 4.5$

Fields are affected by medium
 effect is medium-dependent



$$E = \frac{J}{\kappa \epsilon_0}$$

$$dV = -\vec{E} \cdot d\vec{s}$$

$$|\Delta V| = V_{\text{between plates}} = \frac{J}{\kappa \epsilon_0} d = \frac{Q}{A} \frac{d}{\kappa \epsilon_0}$$

Earlier, w/ no dielectric

$$Q = CV \quad C \text{ was } \frac{\epsilon_0 A}{d}$$

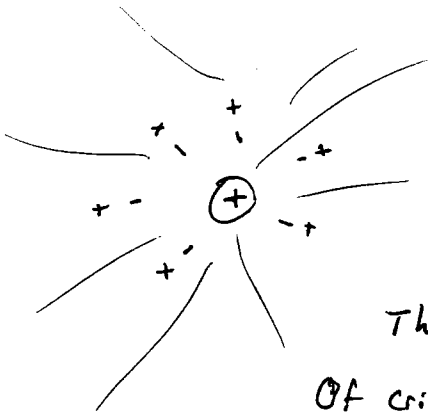
Now

$$C = \frac{\kappa \epsilon_0 A}{d}$$

capacitance is increased!

~~Also~~

for a pt charge imbedded in dielectric



$$E \rightarrow \frac{1}{4\pi \kappa \epsilon_0} \frac{Q}{r^2}$$

$\epsilon_0 \rightarrow \kappa \epsilon_0$

This is all I will say.

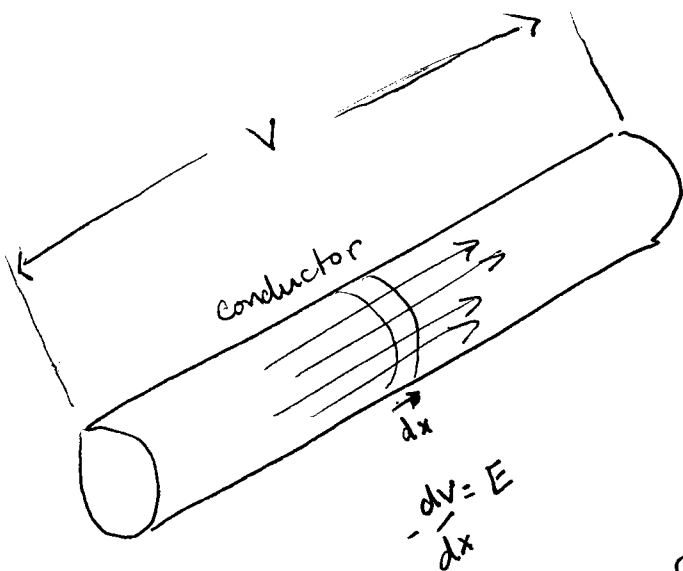
Of critical importance to biology + chemistry

This is something you must deal w/ in real world
 real solutions, real gusses, real cells, real expts.

This is the source of all sorts of optical effects!

~~Remember to read over the MCATS... do work on it
 More lecture time on it.~~

Current and Circuits



use v in place of ΔV \equiv conventional way to simplify notation

length Δx

E for uniform wire

$$E = \frac{V}{L}$$

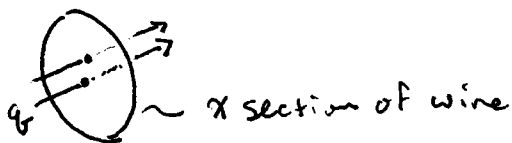
$$-\frac{dv}{dx} = E$$

Charge flows

(Actually electrons)

but convention is \leftarrow

Direction of '+' charge flow is \rightarrow



\sim x section of wire

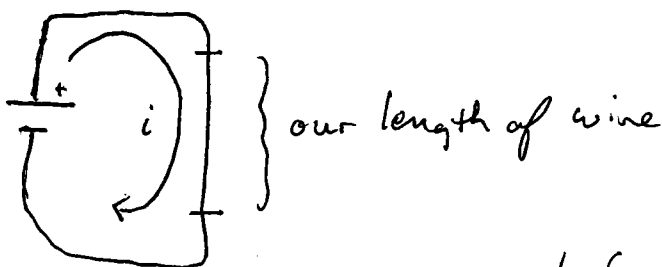
$$\frac{dq}{dt} \equiv \text{Current } i$$

i is \oplus in direction of + charge flow

~~If no other source~~

If little conductor section is isolated Then charge flows until field due to induced charges cancels initial imposed field

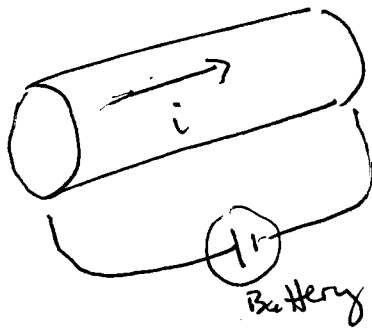
If not isolated but part of a circuit — charge goes around and around



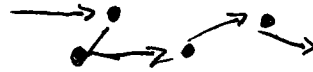
Current units : 1 Ampere = $\frac{1 \text{ Coulomb}}{1 \text{ Second}}$

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National Brand



charge is not continuously accelerated



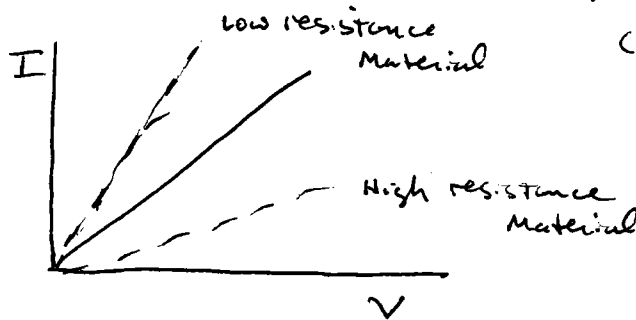
get a steady state equilibrium between i induced by E and lattice atoms

little collisions w/ atoms in the conductor lattice
 Transfer energy from moving charges to the lattice
 (vibration + heat)

For given material get certain i for given V

For ohmic materials $i \propto V$ or $V = iR$
 Resistance

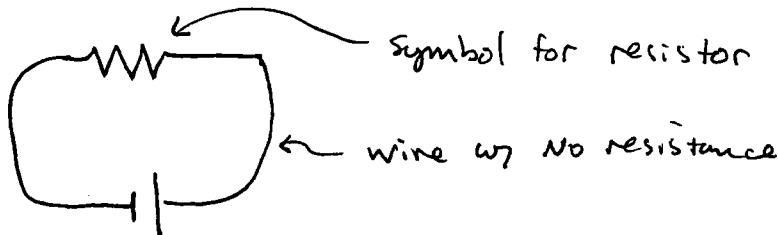
$$1 \Omega \equiv 1 \frac{\text{volt}}{\text{Ampere}} \text{ (ohm)}$$



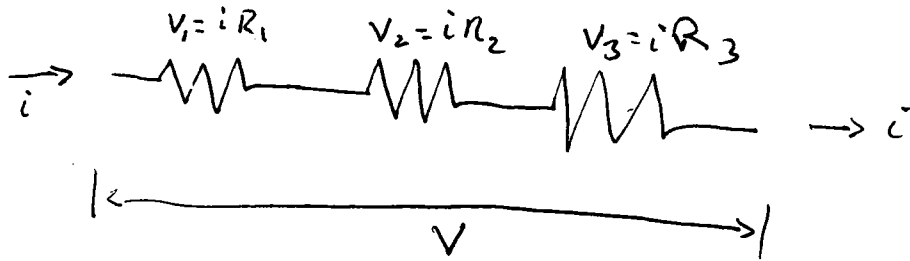
All materials have resistance except something called a "superconductor"

Except when explicitly said in problem - assume metal conductors - wires to have no/low resistance

Circuit Diagram

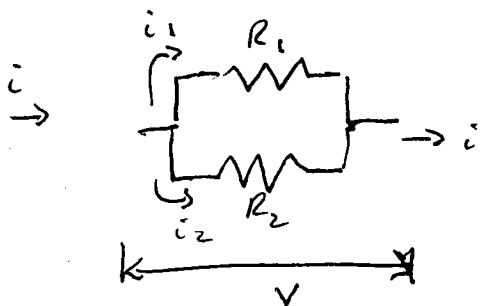


Combinations of Resistors



$$V = V_1 + V_2 + V_3 = i(R_1 + R_2 + R_3)$$

Resistors in series: $R = R_1 + R_2 + R_3$



$$i = i_1 + i_2$$

$$V = iR$$

$$V = V_1 = i_1 R_1$$

$$V = V_2 = i_2 R_2$$

$$\frac{V}{R} = \frac{V}{R_1} + \frac{V}{R_2}$$

$$\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2}$$

Resistors in Parallel

Batteries and EMF

Batteries + Generators: able to maintain

≡ Seats of electromotive force

